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ABSTRACT

This digest discusses how well authentic mathematics assessment tests can be expected to meet the needs of mathematics instruction that focuses on conceptual insights and analytical skills. In the new mathematics curriculum, situational lessons or real-life problems attempt to include dimensions of thinking and reasoning, individual or small-group settings, use of mathematical tools, and student attitudes and dispositions. New assessments require students to formulate problems, devise solutions, and interpret results. Several state assessment programs are engaged in developing new modes of assessment to reflect the emerging consensus on mathematics instruction. In California, for example, educators are developing the following types of assessment items: (1) open-ended questions; (2) short investigations (60- to 90-minute tasks); (3) multiple-choice questions emphasizing understanding of important mathematical ideas and generally involving integrating more than one mathematical concept; and (4) portfolios. The California Mathematics Program has been using open-ended questions for the last 3 years at the 12th-grade level. Currently, only a small sample of student responses are scored, but these exercises provide opportunities for districts to become involved in the state assessment, to administer the essays, and to train teachers to score them. (SLD)

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Authentic Mathematics Assessment

by Tej Pandey, California Department of Education

ED354245

There is a growing consensus among many educators that the fundamental goals of teaching and learning mathematics are to help students solve problems of everyday life, to help them participate intelligently in civic affairs, and to prepare them for jobs, vocations, or professions. These goals suggest that school mathematics should diminish the role of routine computation and focus instead on the conceptual insights and analytical skills that are at the heart of mathematics. New tests are needed to track progress in these areas.

This digest discusses how well authentic mathematics assessment tests can be expected to meet these needs. It defines authentic assessment in relation to more traditional mathematics testing methods. Aspects of the progressive California Mathematics Program, which has been using authentic assessment for several years, are presented.

Emerging Ideas in Authentic Mathematics Assessment

The new mathematics curriculum calls for an instructional setting which is very different from the typical classroom settings of the past. This curriculum combines new as well as traditional topics; mathematics is presented to students in the form of rich situational problems that actively engage the students. The situational lessons or real-life problems attempt to include four dimensions:

- **thinking and reasoning**--engaging in such activities as gathering data, exploring, investigating, interpreting, reasoning, modeling, designing, analyzing, formulating hypotheses, using trial and error, generalizing, and checking solutions
- **settings**--working individually or in small groups
- **mathematical tools**--using symbols, tables, graphs, drawings, calculators, computers, and manipulatives
- **attitudes and dispositions**--including persistence, self-regulation and reflection, participation, and enthusiasm.

In short, students work to construct new knowledge that is integrated with their prior knowledge. The role of the teacher is that of a facilitator. The learning helps students acquire mathematical power to cope with ambiguity, to perceive patterns, and to solve unconventional problems.

Traditionally, assessment has been derived from the curriculum; however, assessment has not been part of a feedback loop linked to instruction. It is now widely believed that assessment must be an integral part of teaching, so that it is used as a tool not merely to collect data, but also to influence instruction. This requires developing and implementing assessment tasks that measure students' productivity, their performance on tasks that require mathematical thinking in pursuit of a result that has meaning to the student. Because these tasks have essentially the same character as instructional tasks, they also have meaning for teachers and, therefore, are useful for improving instruction.

The new assessment tasks require students to formulate problems, devise solutions, and interpret results. While multiple-choice test items can be used to check students' knowledge of some concepts and some of their skills, other modes of assessment may be better for evaluating students' products and their choices of formulation or approach. This means that performance tasks should increasingly become the basis for judging mathematical achievement required for success in the technological world.

Types of Assessments

Several state assessment programs are currently engaged in developing new modes of assessment that reflect the emerging consensus on mathematics instruction

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and evaluation. In California, for example, educators are developing the following types of assessment items:

- **Open-ended questions,** which are 15-minute questions that have a potential to be adopted on a large scale.

- **Short investigations**, which are 60 to 90 minute tasks given to students individually or in groups. The primary emphasis in these tasks is to assess process skills and understanding of mathematical concepts. The students work on these tasks independently, write answers to questions, and are interviewed by the test administrator.

- **Multiple-choice questions,** which emphasize understanding of important mathematical ideas and generally involve integrating more than one mathematical concept. To elicit mathematical thinking, the new multiple-choice questions are typically designed to take 2 to 3 minutes per question.

- **A portfolio**, which is used to assess student attainments over a period of time and includes selections of students' work during the year. The evaluation of portfolios is still being developed, although much has been learned from the pilot programs in California.

In Connecticut, educators are developing **curriculum-assessment modules**. These modules are made up of individual or group tasks that may take a week or more to complete. The tasks are real-life problem-solving situations that require students to use all available resources and tools, including computers.

The California Mathematics Program

Recognizing these emerging ideas in mathematics assessment, California has emphasized the use of open-ended mathematics questions. According to *A Question of Thinking*, a 1989 report from the California State Department of Education, open-ended questions can:

- give students an opportunity to think for themselves and to express the mathematical ideas that are consistent with their mathematical development;

- call for students to construct their own responses instead of choosing a single answer;

- allow students to demonstrate the depth of their understanding of a problem, almost an impossibility with multiple-choice items;

- encourage students to solve problems in many ways, in turn, reminding teachers to use a variety of methods to relate mathematical concepts; and

- model an important ingredient in good classroom instruction: openness to diverse responses to classroom questioning and discussion.

In California, this type of assessment has been in place for the last three years at the twelfth-grade level. Each year new questions are developed and each twelfth-grade student answers one of the questions together with the multiple-choice part of the test. The questions are scored holistically on a six-point scale and reported both separately and in combination with the multiple-choice part of the scores.

Current plans call for an annual assessment using open-ended, performance-based items. All students take the open-ended exercises, but only a relatively small sample of student responses are scored by the state and count toward the total score for a given school. These exercises provide opportunities for districts to become involved in the state assessment, to administer the essays, and to train teachers to score them.

Additional Reading

California Department of Education (1985) *Mathematics framework for California public schools, kindergarten through grade twelve.* Sacramento

California Department of Education (1989) *A question of thinking: A first look at students' perofrmance on open-ended questions in mathematics.* Sacramento

Mumme, J. (1990) *Portfolio assessment in mathematics,* Caliofrnia Mathematics Project, Santa Barbara.

National Council of Teachers of Mathematics. (1989) *Curriculum and Evaluation standards for school mathematics*, Reston, VA.

Stenmark, J. K. (1989) *Assessment alternatives in mathematics, An overview of assessment techniques that promote learning*. Berkeley: EQUALS and the California Mathematics Council.

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